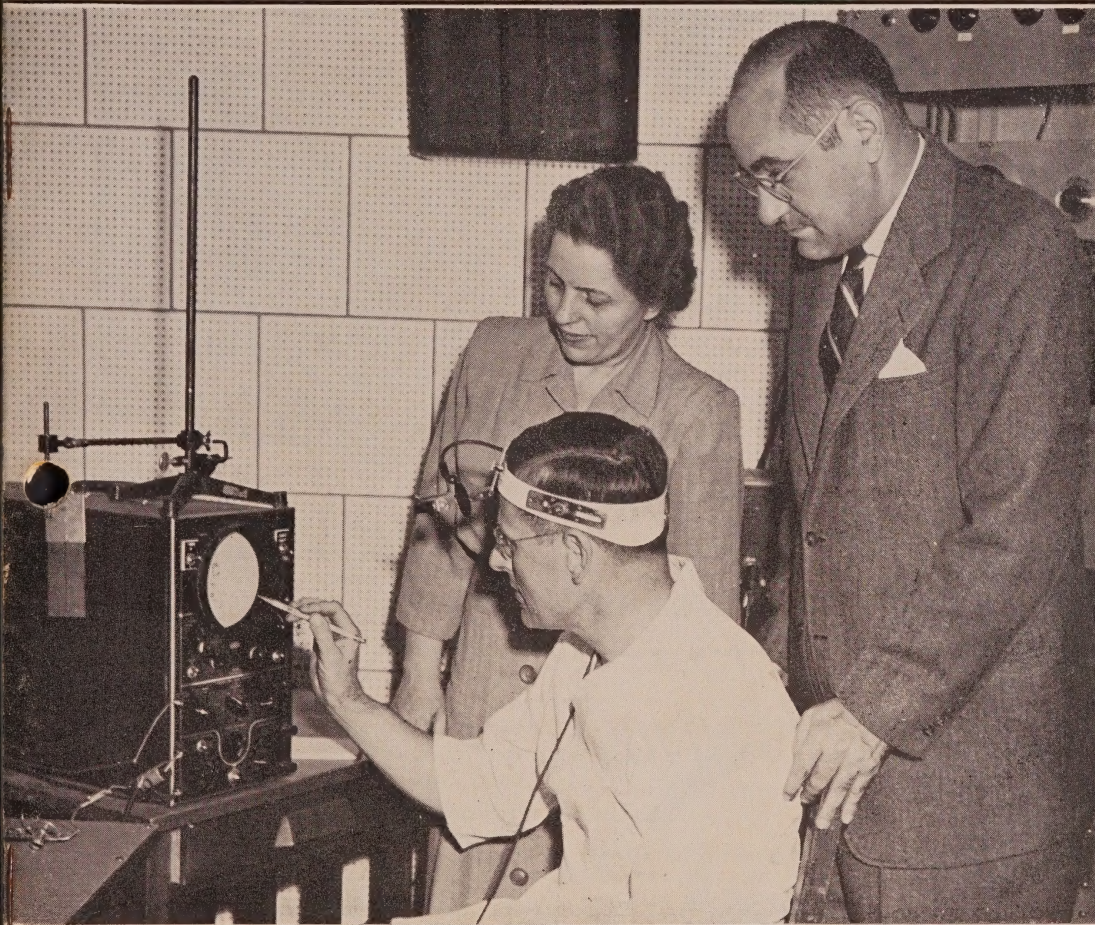


THE

OSCILLOGRAPHER

Vol.10, No. 3

July - Sept., 1948



Du Mont cathode-ray oscillographs are being used widely by the medical profession for research purposes; a typical application is shown in the above photograph. At the Central Institute for the Deaf, St. Louis, Mo., Dr. Hallowell Davis (seated) demonstrates to Drs. Helen Lane and S. Richard Silverman how a Du Mont Type 208-B Oscillograph helps to measure pitches of sound. This measurement is part of an experimental program to study the nature of hearing and means for solving the problems of impaired hearing.

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The Du Mont Type 279 Dual-beam Cathode-ray Oscilloscope

by

Melvin B. Kline*

To meet the needs of scientists for making observations and recordings of dual-trace oscillograms without the limitations of electronic switches and other time-sharing devices, and without the high-frequency restrictions of the string oscillograph, Allen B. Du Mont Laboratories, Inc. has developed the Type 279 Dual-beam Cathode-ray Oscilloscope. This instrument makes use of the Du Mont Type 5SP- series of dual-beam cathode-ray tubes.** Used in conjunction with either the Du Mont Type 271-A*** or 314 Oscilloscope-record Camera, permanent two-channel records are quickly and easily made.

*Head, Development Engineering Section, Instrument Division, Allen B. Du Mont Laboratories, Inc.

**See: "The Du Mont Type 5SP- Dual-beam Cathode-ray Tube", by Kurtz, M., *Oscillographer*, Sept.-Oct. 1945, vol. 7, no. 5.

***See: "The Type 271-A Oscilloscope-record Camera", by Berkley, C., *Oscillographer*, Jan.-March 1948, vol. 10, no. 1.

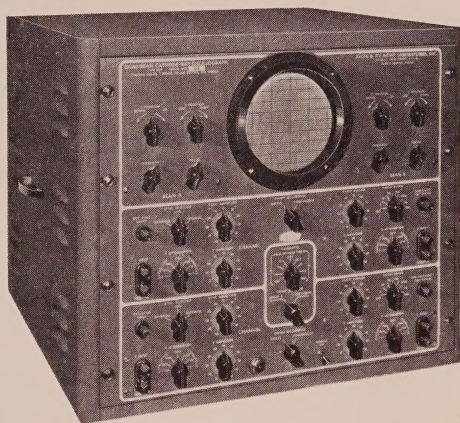


Figure 1
The Du Mont Type 279 Dual-beam Cathode-ray Oscilloscope.

THE OSCILLOGRAPHER

The purpose of this publication is to provide information on new developments and applications of the cathode-ray oscillograph and related apparatus.

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The Type 279 Oscilloscope consists of the cathode-ray tube with its associated beam-control circuits, d-c horizontal and vertical-deflection amplifier systems for each gun, separate sweep circuits for each channel, or a common sweep for both, Z-axis or intensity-modulation circuits, a built-in voltage calibrator, and the associated power supply circuits, all housed in a gray wrinkle-finished cabinet. A standard rack-type panel is used so that the instrument may be mounted in a relay rack.

A total accelerating potential of 4,500 volts assures a picture of high brightness. Each channel is equipped with separate controls for intensity, focus, X- and Y-position.

Identical balanced, direct-coupled deflection amplifiers are used for both sets

of deflection systems.

The utility of the d-c amplifiers is well represented in Figure 2 in which one channel of the Y-axis amplifiers of the instrument displays an absolute-zero voltage reference. This reference, used in conjunction with the second channel of the oscillograph, shows clearly that the signal impressed upon the second channel contains a d-c as well as an a-c component, and that the magnitude of both can be measured precisely.

Compensated, stepped attenuators precede each amplifier. The attenuator switches allow either d-c operation or the insertion of a blocking capacitor to provide for those cases where it is desirable to observe a-c components superimposed on large d-c voltages without having the d-c potential cause off-screen deflection. These capacitors have 1,000-volt ratings, thus allowing observation of signals having large a-c or d-c amplitudes.

Connection to the deflection plates is possible at the rear terminal panel. Capacitive coupling is used, and positioning is possible at all times.

The frequency response curves, Figures 3 and 4 show that there is negligible frequency discrimination for any setting of the gain control. This is important

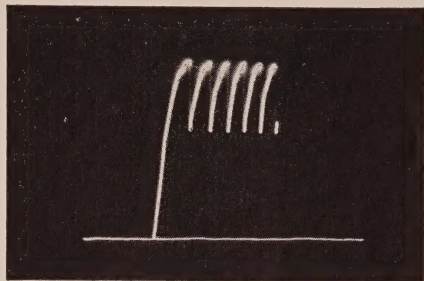


Figure 2

Dual-trace Oscillogram Showing an Absolute-zero, Voltage-reference Trace Provided by One Channel to Facilitate Measurement of the D-C and A-C Components of a Signal Represented by the Second Trace.

if the performance of the instrument is to be faithful throughout its operating range.

A built-in voltage calibrator can be switched into either Y-axis circuit ahead of the input attenuator so that the instrument may be calibrated for any setting of the gain control. It is not necessary to remove signal leads from the oscillograph when this is done.

Connection to the cathode of either or both electron guns of the cathode-ray tube is possible at the rear panel of the

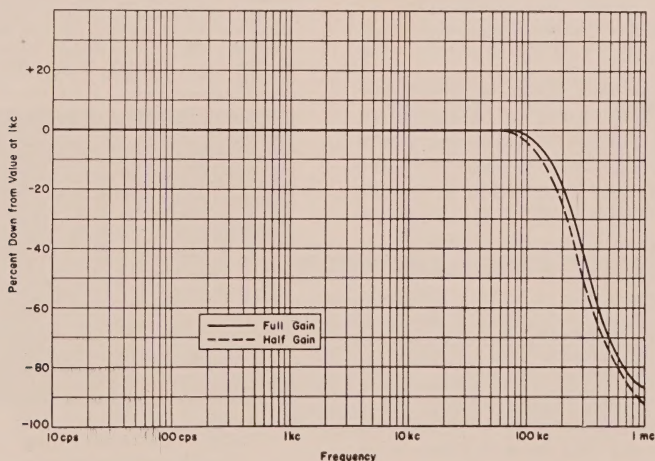


Figure 3

Average Frequency-response Curves for the Y-axis Amplifiers.

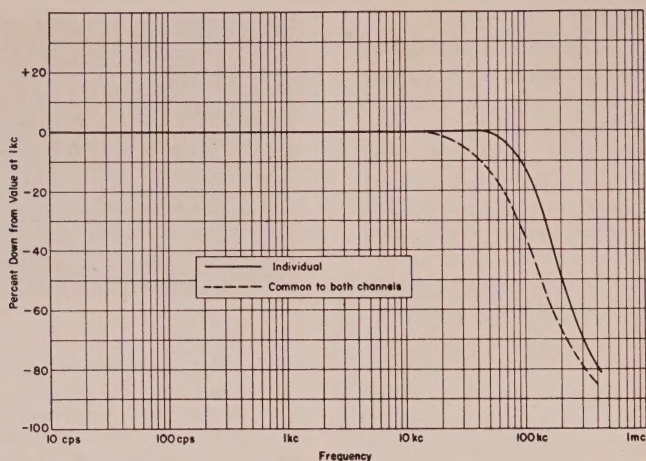


Figure 4
Average Frequency-response Curves for the X-axis Amplifier.

instrument. These cathodes are connected to the terminals through capacitors, there being no amplifiers.

Identical linear time-bases are provided for each beam. When continuous sweep is used, the return trace is blanked. Single-sweep operation is also possible with automatic beam control, so that the spot is extinguished except during the time that the beam is being swept. This feature, along with high brightness, makes the instrument ideally suited for photographic work or observation of single transients with relatively high writing rates.

Provision is also made to allow one of the time-base signals to be applied to both sets of horizontal deflection plates to provide a common time-base to facilitate the study and comparison of related phenomena. Factory-adjusted correction circuits in the instrument enable exact superposition of both time-base traces for such operation.

Applications

The dual-beam oscillograph offers many distinct advantages over the conventional oscillograph for certain types of measurements and investigations such as the comparison of the waveform of a complete signal and an expanded por-

tion of this waveform. An example of this is shown in Figure 6 in which is shown a damped oscillation and an expanded portion of the first few cycles.

Another example is shown in Figure 7 in which the complex waveform of a fluorescent lamp circuit is shown as the upper trace and an expanded portion of this same waveform is shown as the lower trace.

With suitable external circuits, A and R types of displays may be observed*

*An "A" display is a display during an interval with the sweep starting at the beginning of the interval. An "R" display is an expanded portion of the "A" display, which may generally be delayed after the start of the "A" display by a controllable, variable, finite time.



Figure 5
Dual-trace Oscillogram Showing the Phase Difference between Two Sine Waves Displayed on a Common Time Base.

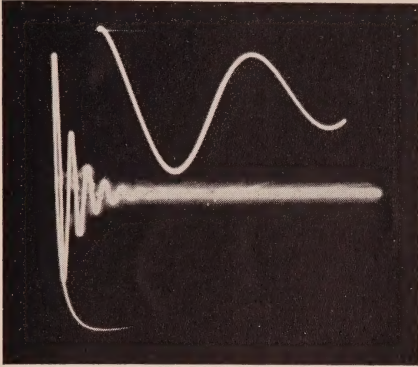


Figure 6

Dual-trace Oscillogram of a Damped Oscillation—The upper trace is an expanded portion of the lower trace.

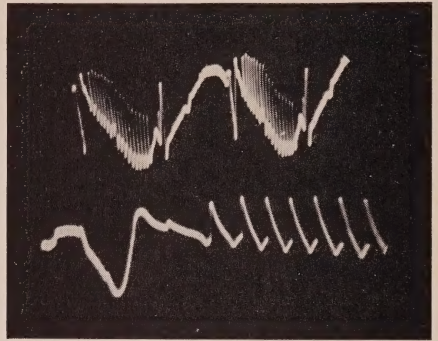


Figure 7

Dual-trace Oscillogram of the Complex Waveform of a Fluorescent Lamp Circuit—The lower trace is an expanded portion of the upper trace.

With displays of this type, as often used in radar, the radar operator may examine the target in detail on the R-sweep and still be able to observe new targets as they appear on the A-sweep outside of the field of the R-sweep. This same technique is often of value in the study of other electrical and physical phenomena.

Another important use of the dual-beam cathode-ray oscillograph is the comparison of voltage and current characteristics of a circuit. An example of this, the starting characteristics of a fluorescent lamp, is shown in Figure 8. This photograph was taken with the Du Mont Type 314 Oscillograph-record Camera*.

Other applications include the measurement of explosion burning rate and

rate of change of pressure; velocity and acceleration; speed and vibration studies; comparison of multiphase circuits; comparison of the input and output signals of amplifiers to show how the output signal varies in amplitude, phase, and wave-shape with variations of the input signal; adjustment of push-pull and other symmetrical circuits; comparison of electrocardiograms; the study of neurological reactions to stimulus; and plotting static or dynamic plate and transfer characteristics of vacuum tubes.

By making use of the common sweep, phase comparisons are easily made. This is shown in the oscillogram of Figure 5.

Used with the Du Mont Type 314 Oscillograph-record Camera, dual-channel recordings may be made at speeds ranging from one inch per minute to five feet per second. The d-c response

*To be described in the next issue of the Oscillographer.

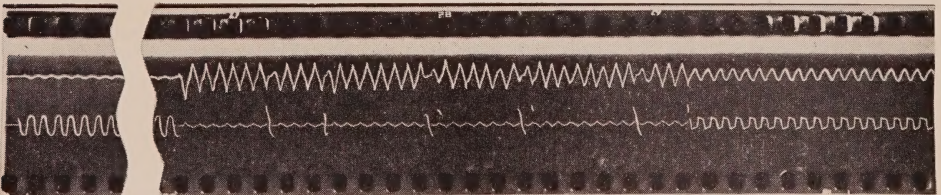


Figure 8

Dual-trace Oscillogram Displaying the Voltage and Current Characteristics of a Fluorescent Lamp During the Starting Period.

characteristics of the amplifier enable recording of slowly changing phenomena over long periods. At the lowest speed of the Type 314 Camera, dual-channel recordings of 20 hours in duration are possible.

The Du Mont Type 271-A Oscillograph-record Camera may be used for single-frame recordings. It may be easily clamped to a mounting bezel provided on the Type 279 Oscillograph.

Specifications

CATHODE-RAY TUBE

Type 5SP- Dual-beam
Total Accelerating Potential 4500 volts

INPUT CIRCUITS

X- and Y-axis Amplifiers

Input Coupling capacitive or conductive
Attenuators 1:1, 10:1, 100:1 (stepped)
..... 10:1 (variable)
Impedance 2 meg, 60 μ f

Direct to Deflection Plates

Input Coupling capacitive only
Impedance—single-ended 1 meg, 20 μ f
..... balanced 2 meg, 20 μ f

Z-axis

Input Coupling capacitive to cathode of cathode-ray tube
Polarity positive signal decreases intensity
Input Impedance 10,000 ohms, 40 μ f

AMPLIFIERS

Response

	Sine Wave	Square Wave
Low-frequency (all amplifiers)		
Capacitive Input	within 1 db @ 10 cps	10% saw @ 10 cps
Direct Input	flat to dc	
High-freq. down not more than 1 db @	3 db @	No Distortion @
Y-axes	100 kc	200 kc
X-axes (Individual)	70 kc	150 kc
X-axis (A-common)	40 kc	70 kc

Deflection Factor

Through Amplifiers better than 0.35 v (rms) or 1 v (d-c)/in.
Direct to X-plates 25 v (rms) or 69 v (d-c)/in. $\pm 20\%$
Direct to Y-plates 29 v (rms) or 80 v (d-c)/in. $\pm 20\%$

LINEAR TIME-BASE GENERATOR

Frequency Range 2-30,000 cps
Sweep Recurrence single or continuous
Common Sweep provision made for Sweep A to deflect both beams simultaneously with correction to allow superposition of time-base traces

Blanking

Continuous Sweep return-trace blanked
Single Sweep beam on only during sweep

Sweep Output sweep A from front-panel terminal

Sync Circuits

Type of Signals int. (Y), ext, or power-line frequency
Polarity positive or negative

VOLTAGE CALIBRATOR

Availability	either Y-axis through input attenuator but not simultaneously
Voltage	0.1, 1, 10, 100 volts $\pm 5\%$
Waveform	square-wave at line frequency

MISCELLANEOUS

A-C Test Signal	power-line frequency from front-panel terminal
Positioning	instantaneous with amplifier, possible at all times

POWER SOURCE

Voltage	115/230 volts $\pm 10\%$
Frequency	50-60 cps
Power Consumption	300 watts

MECHANICAL

Size	17½ in. high by 22⅝ in. wide by 22⅝ in. deep
Weight	125 pounds
Mounting	cabinet or relay rack

CATALOG TYPE		DESCRIPTION	CODE WORD
1386-E	279	Dual-beam Cathode-ray Oscillograph for 115 v, 50-60 cps operation with Type 5SP1 Cathode-ray Tube	YALHR
1387-E	279	Same as 1386-E with Type 5SP2* Cathode-ray Tube	YALHS
1390-E	279	Same as 1386-E with Type 5SP11** Cathode-ray Tube	YALHV
1391-E	279	Dual-beam Cathode-ray Oscillograph for 230 v, 50-60 cps operation with Type 5SP1 Cathode-ray Tube	YALHW
1392-E	279	Same as 1391-E with Type 5SP2 Cathode-ray Tube	YALHX
1395-E	279	Same as 1391-E with Type 5SP11 Cathode-ray Tube	YALJA

*Long-persistent screen, recommended for observation of very low-frequency recurrent signals or single transients.

**Short-persistent, blue screen, for photographic records.

CATHODE-RAY OSCILLOGRAPH APPLICATIONS IN THE TEXTILE FIELD

An abstract, the original article was written by Morton Scheraga (Market Research, Allen B. Du Mont Laboratories, Inc.), and appeared in the Nov., 1947 Proceedings of the Textile Research Institute.

Until recently, the primary emphasis on cathode-ray oscillograph design has been placed on the needs of the electronics industry. The oscillograph has assisted materially in developing such fields as television, radar, nuclear fission, and modern, high-speed calculating machines. However, the oscillograph is now becoming increasingly important in the mechanical field as an aid in the development of new machinery and also as a production-control instrument.

At the 1946 meeting of the Textile Research Institute, Allen B. Du Mont Laboratories, Inc. introduced a new type of cathode-ray instrument (the Type 275-A Polar-coordinate Indicator) spe-

cifically designed for the needs of the mechanical industry and demonstrated how it could be applied to the study of textile machinery.

The possibility of *examining and adjusting textile machinery under actual operating conditions* is basically interesting because of its importance in the textile industry, as a result, several joint research programs were set up by various groups in conjunction with Allen B. Du Mont Laboratories, in order to investigate specific applications of cathode-ray oscillographs to the problems of the textile field.

Cathode-ray Oscillograph as a Research Tool — To illustrate the use of the cath-

ode-ray oscillograph in the development and improvement of textile machinery, one project was set up in which it was desired to examine the starting characteristics of a high-speed sewing machine to determine the number of cycles of the motor and the time elapsed for the machine to build up to full speed. For this application, a standard Du Mont Type 247 Cathode-ray Oscillograph was employed.

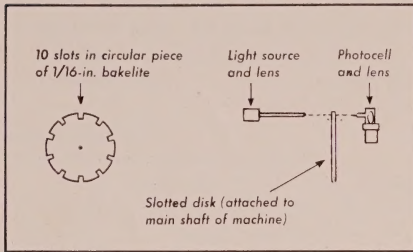


Figure 1

Arrangement of Slotted Disc and Photocell Pick-up for Determining Starting Speed Characteristic of a Sewing Machine.

The simple set-up for this study is illustrated in Figure 1. A disc with ten slots is attached to the drive shaft of the machine. This disc interrupts the beam from the light source to the photocell. For every revolution of the disc there are produced ten pulses of light, which produce ten pulses of electricity at the photocell. These pulses are all of the same amplitude, but their length and sep-

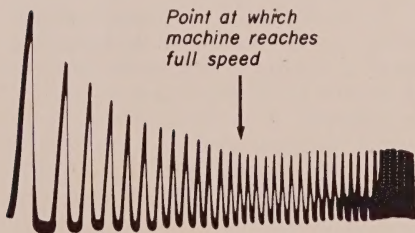


Figure 2

Starting Characteristic of a Sewing Machine Shown as an Amplitude Variation.

aration are inversely proportional to the speed of the machine. To facilitate the observations, an accessory circuit was added which changes the pulses of varying frequency into pulses of varying amplitude. A typical starting characteristic of a high-speed sewing machine obtained by this method is shown in figure 2.

Cathode-ray Oscillograph as a Production Tool — The Du Mont Type 275-A Polar-coordinate Indicator may be applied to the study of the operation and adjustment of looms. The present practice for timing looms is to adjust them at low speeds, using the "feel" and experience of the loom fixer. It is impossible, however, to ascertain whether the loom is operating correctly at high speeds, or to know whether cloth woven on a loom

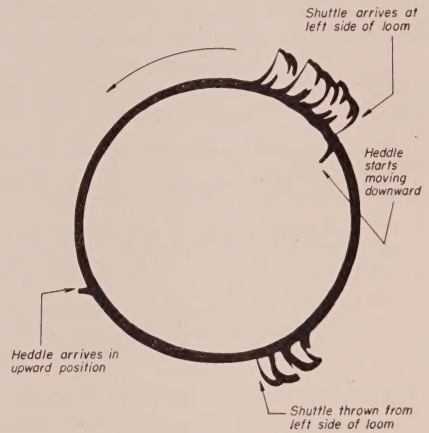


Figure 3
Shuttle-Heddle Timing

adjusted by one fixer will be the same as cloth from another loom.

With the aid of suitable pick-ups and several micro-switches, the motions of the various parts of the loom were accurately and quantitatively shown.

Some results and comments from a preliminary report by Dr. Hugh M. Brown, Dean of the School of Textiles of Clemson College, on a study of such applications to textile machinery follow:

"Measurements on looms with the Polar-coordinate Indicator—we have been able to check timing of the shedding, picking, boxing, stop motions, and shuttle speeds.

"Shedding Timing — The timing is recorded as the angle in degrees from the crank at top-center to where the pip occurs. The indication is very accurate, as the harnesses are moving at maximum speed at their level position where they trip the probe.

"Picking Timing — This measurement gives dynamic timing of the pick and is often later than the loom fixer expects from his setting made statically.

"This measurement is one that can-

not be made from a static setting and is important since it may measure undue holding of the shuttle in the box or may be due to looseness of lug straps, etc. From these last measurements it is known whether the picking power is correct. This is another important factor which is difficult to determine by usual methods.

"We are surprised how quickly these readings can be taken on a loom; we think the time is possibly less than 2 or 3 minutes per loom.

"We suggest looking into the possibility of wiring a loom room with multi-strand cable for connecting the probe and the generator, leaving the Polar-coordinate Indicator in a central laboratory."

OPERATING NOTE ON THE TYPE 248 CATHODE-RAY OSCILLOGRAPH

It is possible to improve the brightness of an oscillogram obtained during driven-sweep operation of a Type 248 Oscillograph without making any changes in the instrument. This increase in brightness can be accomplished by connecting the SWEEP SAWTOOTH SIGNAL terminal on the panel to the input terminal of the Z-axis amplifier, and setting the Z-axis gain control at "—100."

The large input signal completely saturates the Z-axis amplifier and it provides uniform and increased brightness with constant focus for practically the entire trace. This procedure applies to driven-sweep operation only.

The increase in brightness obtained by this method can be determined by a comparison of the intensity achieved with the intensity ordinarily obtained when the Z-axis gain control is at zero.

The following tables contain the results of measurements of maximum writing rates of an early Type 248 oscillograph* with and without the sweep signal applied to the Z-axis amplifier.

*Type 248 Oscillographs in current production are capable of producing oscillograms at greater writing rates. The Type 248-A Oscillograph, employing the new, fast-writing Du Mont Type 5RP-A Cathode-ray Tube, and which is capable of much superior performance, is described in the Jan.-Feb., 1947 issue of the Oscillographer, Vol. 9, No. 1.

Direct Observation of Single Transients

	Max. Freq. mc	Max. Amplitude in. (peak-to-peak)	Writing Rate km/sec	in./μsec
Without Pulse	3	0.4	100	4
With Pulse	3	4	1000	40

Observations made in semi-darkness with dark-adapted eyes, linear portion of sine wave just recognizable.

Photographic Recording of Single Transients*

	Max. Freq. kc	Max. Amplitude in. (peak-to-peak)	Max. Writing Rate Referred to f/1 lens and M of 1:1* km/sec	in./μsec
Without Pulse	50	2	35	1.4
With Pulse	250	2	175	7

*With the Type 271-A Oscillograph-record Camera, f/3.5 lens, and M of 4.5:1 (screen-image-to-negative-image ratio), Eastman Linagraph Ortho (5211) film; development: D-72, 5 min.

The above tables show an increase of five to ten times in the writing rates as a result of this method of operation of an early model Type 248 Oscillograph employing a Type 5JP Cathode-ray Tube.

BIBLIOGRAPHY

The following bibliography of papers selected from contemporary publications may be of interest to those engaged in the application of the cathode-ray oscillograph.

Cathode-ray Oscillographs

"Random Fluctuations in a Cathode-ray Oscillograph," by Campbell, N. R., and Francis, V. J., *London, Edinburgh, Dublin Philosophical Magazine and Journal of Science (monthly, London)*, May 1946, vol. 37, no. 268, pg. 289.

"Les oscillographes pour phenomenes transitoires rapides," by Grassot, P., *Société Française des Electriciens — Bulletin (monthly, Paris)*, Feb. 1947, vol. 7, no. 66, pg. 95.

"A Portable Two-Channel Recording Oscillograph for Battery Operation," by Wild, R. F., *Instruments (monthly, The Instruments Publishing Co., Inc., Pittsburgh)*, June 1947, vol. 20, no. 6, pg. 536.

"Oscilloscope for Very Low Frequencies," by Juster, F., *Toute la Radio*, Oct. 1947, vol. 14, no. 119, pg. 270.

"A Laboratory Oscilloscope," by Fitch, V. L., and Titterton, E. W., *The Review of Scientific Instruments (monthly, American Institute of Physics, N. Y.)*, Nov. 1947, vol. 18, no. 11, pg. 821.

"A Cathode-ray Oscilloscope with Two Push-Pull Amplifiers," by Carpenter, E. E., *Philips Technical Review (monthly, Eindhoven, Netherlands)*, 1947, vol. 9, no. 7, pg. 202.

Cathode-ray Tubes

"An Examination of Cathode-ray Tube Screen Characteristics," by Hopkinson, R. G., *Journal of the Institution of Electrical Engineers*, part 3A (*quarterly, London*), 1946, vol. 93, no. 5, pg. 779.

"Aluminum Backed Phosphor Screen in Cathode-ray Tubes," by Bramley, A., *Electrochemical Soc. (New York)*, preprint no. 91-30 for meeting of April 8-12, 1947, pg. 463.

"Silicate Phosphors for Cathode-ray Tubes," by Campbell, P. N., *Journal of the Society Chemical Industry (London)*, June 1947, vol. 66, no. 6, pg. 191.

"Electron-beam Deflection — Part I, Small angle Deflection Theory," by Hutter, R. G. E., *Journal of Applied Physics (monthly, American Institute of Physics, N. Y.)*, Aug. 1947, vol. 18, no. 8, p. 740.

"Electron-beam Deflection—Part II, Applications of the Small-angle Deflection Theory," by Hutter, R. G. E., *Journal of Applied Physics (monthly, American Institute of Physics, N. Y.)*, Sept. 1947, vol. 18, no. 9, p. 797.

"The Choice of the Cathode-ray Tube," by Chretien, L., *Toute la Radio*, Nov. 1947, vol. 14, no. 120, pg. 321.

"Application of Chemically Unstable Phosphors to Cathode-ray Tubes," by Head, R. B., *Electronic Engineering (monthly, London)*, Nov. 1947, vol. 19, no. 237, pg. 363.

"Performance Characteristics of Long-Persistence Cathode-ray Tube Screens: Their Measurement and Control," by Johnson and Hardy, *RCA Review*, Dec. 1947, vol. 8, no. 4, pg. 660.

"Applications of Luminescent Substances," by Kroger, F. A., *Philips Technical Review (monthly, Eindhoven, Netherlands)*, 1947, vol. 9, no. 7, pg. 215.

"Improvements in the Construction of Cathode-ray Tubes," by de Gier, J., and van Rooy, A. P., *Philips Technical Review (monthly Eindhoven, Netherlands)*, 1947, vol. 9, no. 6, pg. 180.

"Visual Photometer for After-Glow Tests on Cathode-ray Tube Screens," by White, W. G., *Journal of Scientific Instruments (monthly, Institute of Physics, London)*, Jan. 1948, vol. 25, no. 1, pg. 1.

"Testing Long-Persistence Screens," by Tiller, J. C., and Fisher, J. F., *Electronics*, Feb. 1948, vol. 21, no. 2, pg. 126.

Applications of the Cathode-ray Oscillograph

"Cathode-ray Oscillograph for Detection of Low Voltage D. C. Signals," by Guelke, R., Bisseling, J., Newbery, E., and Semmelink, A., *Faraday Society — Transactions (monthly, London)*, March 1947, vol. 43, no. 294, pg. 123.

"Visual Measurement of Receiver Noise," by Williams, D., *Wireless Engineer, (monthly, London)*, April 1947, vol. 24, no. 283, pg. 100.

"Recording Oscilloscope Images," *Tele-Tech (monthly, Caldwell-Clements, Inc., N. Y.)*, April 1947, vol. 6, no. 4, pg. 45.

"Cathode-ray Tube Shutter-testing Instrument," by Dighton, D. T. R., and Ross, H. Mc G., *Journal of Scientific Instruments (monthly, Institute of Physics, London)*, May 1947, vol. 24, no. 5, pg. 128.

"Measurement of the HT by CRT," *Electronic Engineering (monthly, London)*, June 1947, pg. 177.

"Use of the Cathode-ray Oscillograph for Studying the Near Infra-Red Solar Spectrum," by Nomin, A. U., *Nature (weekly, London)*, July 26, 1947, vol. 160, pg. 120.

"Cathode-ray Presentation of Three-dimensional Data," by Schmitt, O. H., *Journal of Applied Physics (monthly, American Institute of Physics, N. Y.)*, Sept. 1947, vol. 18, no. 9, pg. 819.

BIBLIOGRAPHY

"Cathode-ray Oscillograph Applications in the Textile Field," by Scheraga, M., Proc. of the Textile Research Institute (*New York*), Nov. 13-15, 1947, pg. 34.

"Number Display Using the Cathode-ray Tube," by Baker, G. T., Journal of the Institution of Electrical Engineers, part 3, (*quarterly, London*), Nov. 1947, vol. 94, no. 32, pg. 421.

"An Oscillographic Method of Presenting Impedances on the Reflection-Coefficient Plane," by Samuel, A. L., Proc. of the I.R.E., Nov. 1947, vol. 35, no. 11, pg. 1279.

"Producing Tube Curves on Oscilloscope," by Webking, H. E., Electronics, Nov. 1947, vol. 20, no. 11, pg. 128.

"Measuring the Rate of Watches with a Cathode-ray Oscillograph," by van Suchtelen, H., Phillips Technical Review (*monthly, Eindhoven, Netherlands*), 1947/1948, vol. 9, no. 10, pg. 317.

"Cathode-ray Oscillograph Images of Noise Reduction Envelopes," by Denney, B. H., Journal of the Soc. of Motion Picture Engineers (*monthly, N. Y.*), Jan. 1948, vol. 50, no. 1, pg. 37.

"Stereoscopic Viewing of Cathode-ray Tube Presentations," by Iams, H., Burtner, R., and Chandler, C., RCA Review, March 1948, vol. 9, no. 1, pg. 149.

Circuits

"A Linear Time Base of Wide Range," by Gibbs, D. F., and Rushton, W. A. H., Journal of Scientific Instruments (*monthly, Institute of Physics, London*), Nov. 1946, vol. 23, no. 11, pg. 270.

"Bandwidth and Speed of Buildup as Performance Criteria for Pulse and Television Amplifiers," by Tucker, D. G., Journal of the Institution of Electrical Engineers, part 3 (*quarterly, London*), May 1947, vol. 94, no. 29, pg. 218.

"Diode-controlled Voltage Regulators," by Helterline, L., Electronics, June 1947, vol. 20, no. 6, pg. 96.

"Input Admittance of Cathode-follower Amplifiers," by Reich, H. J., Proc. of the I.R.E., June 1947, vol. 35, no. 6, pg. 573.

"Cathode-follower Nomograph," by Kline, M. B., Electronics, May 1947, vol. 20, no. 5, pg. 136, June 1947, vol. 20, no. 6, pg. 136, July 1947, vol. 20, no. 7, pg. 130.

"Television E. H. T. Supply," by Cocking, W. T., Wireless World and Radio Review (*monthly, London*), June 1947, vol. 53, no. 6, pg. 207.

"Theory and Practice of Constant Voltage Transformers for Radio Power Supplies," by Burdick, R. H., Marconi Review (*bi-monthly, London*), July-Sept. 1947, vol. 10, no. 3, pg. 102.

"Design of Regulated Power Source," by

Helterline, L. L., Tele-Tech (*monthly, Caldwell-Clements, Inc., N. Y.*), July 1947, vol. 6, no. 7, pg. 63.

"Wide-Range Sweeping Oscillator," Electronics, August 1947, vol. 20, no. 8, pg. 112.

"Gain Chart for Cathode Followers," by Houck, G., Tele-Tech (*monthly, Caldwell-Clements, Inc., N. Y.*), Aug. 1947, vol. 6, no. 8, pg. 54.

"Wide Band Oscilloscope Amplifier," by Hallmark, C. E., Tele-Tech (*monthly, Caldwell-Clements, Inc., N. Y.*), Aug. 1947, vol. 6, no. 8, pg. 38.

"Pulsed Rectifiers for Television Receivers," by Maloff, I. G., Electronics, Aug. 1947, vol. 20, no. 8, pg. 110.

"Spray-Installing Electrical Circuits," by Collier, J. T., Steel (*weekly, Penton Publishing Co., Cleveland*), Sept. 15, 1947, vol. 121, no. 11, pg. 96.

"Method of Graphically Analyzing Cathode-Degenerated Amplifier Stages," by Lonsdale, E. M., and Main, W. F., Proc. of the I.R.E., Sept. 1947, vol. 35, no. 9, pg. 981.

"Resistance-Tuned Frequency-Modulated Oscillator for Audio-Frequency Applications," by McGaughan, H., and Leslie, C., Proc. of the I.R.E., Sept. 1947, vol. 35, no. 9, pg. 974.

"Magnetic-Deflection Circuits for Cathode-ray Tubes," by Schade, O. H., RCA Review, Sept. 1947, vol. 8, no. 3, pg. 506.

"Cathode-follower Gate Circuit," by Kurshan, J., Review of Scientific Instruments (*monthly, American Institute of Physics, N. Y.*), Sept. 1947, vol. 18, no. 9, pg. 647.

"D-C Amplifier for Low-Level Signals," by Aiken, C. B., and Welz, W. C., Electronics, Oct. 1947, vol. 20, no. 10, pg. 124.

"Oscilloscope Time-Base Circuit," by den Hartog, H., and Muller, F. A., Wireless Engineer (*monthly, London*), Oct. 1947, vol. 24, no. 289, pg. 287.

"Electromechanical D-C Amplifier," by Roper, C. G., and Engelberger, J. F., Electronics, Nov. 1947, vol. 20, no. 11, pg. 117.

"Improved Wide-Band Wobbulator," by Smith, C. P., Tele-Tech (*monthly, Caldwell-Clements, Inc., N. Y.*), Nov. 1947, vol. 6, no. 11, pg. 42.

"Push-Pull Balance," by Cocking, W. T., Wireless World and Radio Review (*monthly, London*), Nov. 1947, vol. 53, no. 11, pg. 408.

"Wide-Band 550-Megacycle Amplifier," by Petrich, R. O., Proc. of the I.R.E., Nov. 1947, vol. 35, no. 11, pg. 1371.

"D. C. Amplifiers with Automatic Zero Adjustment and Input Current Compensation," by Prinz, D. G., Journal of Scientific Instruments (*monthly, London*), Dec. 1947, vol. 24, no. 12, pg. 328.

"Present Status of Printed Circuit Technics," by Murray, A. F., Tele-Tech (*monthly, Cald-*

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In the control room of the giant cyclotron of the University of California, Drs. Lattes and Gardner watch instruments which show progress of meson-producing experiment. The artificial production of the meson is considered one of the greatest advances in basic science since the discovery of uranium fusion. The Du Mont Type 208-B Oscillographs, in the top of the picture, greatly aided this research.

BIBLIOGRAPHY — (Continued)

well-Clements, Inc., N. Y.), Dec. 1947, vol. 6, no. 12, pg. 29.

"Phase and Amplitude Distortion in Linear Networks," by De Toro, M. J., *Proc. of the I.R.E.*, Jan. 1948, vol. 36, no. 1, pg. 24.

"The Transient Response of Damped Linear Networks with Particular Regard to Wide-band Amplifier," by Elmore, W. C., *Journal of Applied Physics* (*monthly, American Institute of Physics*, N. Y.), Jan. 1948, vol. 19, no. 1, pg. 55.

"Temperature Coefficients in Electronic Circuits," by Soucy, C. I., *Electronics*, Jan. 1948, vol. 21 no. 1, pg. 117.

"The Cathode Follower—Part II," by Parker, E., *Electronic Engineering* (*monthly, London*), Feb. 1948, vol. 20, no. 240, pg. 55.

"Degenerative Positive Multivibrator," by Bertram, S., *Proc. of the I.R.E.*, Feb. 1948, vol. 36, no. 2, pg. 277.

"Filter Ripple Chart," by Hooper, C. K., *Electronics*, March 1948, vol. 21, no. 3, pg. 132.

"Circle Diagrams for Cathode Followers," by Diamond, J. M., *Proc. of the I.R.E.*, March 1948, vol. 36, no. 3, pg. 416.

Measurements

"Precision Device for Measurement of Pulse-width and Pulse-slope," by Morrison, H. L., *RCA Review*, June 1947, vol. 8, no. 2, pg. 276.

"Rectifier Amplifier Vacuum Tube Voltmeter," *Electrical News and Engineering* (*semi-monthly, Toronto*), June 1947, vol. 50, no. 12, pg. 147.

"Measuring Instantaneous Frequency of F.M. Oscillator," by Hunt, L. E., *Tele-Tech* (*monthly, Caldwell-Clements, Inc.*, N. Y.), Dec. 1947, vol. 6, no. 12, pg. 34.

"Visual Measurements of Short Pulses of Direct Current," by Ordung, P. F., *Journal of the Franklin Institute* (*monthly, Lancaster, Pa.*), Jan. 1948, vol. 245, no. 1, pg. 37.

"High-Voltage Measurement," by Levinton, H. L., *Electrical Engineering* (*monthly, AIEE*, N. Y.), Feb. 1948, vol. 67, no. 2, pg. 154.

General

"Stamped Wiring," *Electronics*, June 1947, vol. 20, no. 6, pg. 82.

"Printed Vitreous Enamel Components," by Bradford, C. I., et al, *Electronics*, Dec. 1947, vol. 20, no. 12, pg. 106.